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from J. W. B.

NOTICE

OF A

MEMOIR BY C. G. EHRENBERG,

ON THE

EXTENT AND INFLUENCE

OF

MICROSCOPIC LIFE

IN

NORTH AND SOUTH AMERICA.

EXTRACTED FROM THE AMERICAN JOURNAL OF SCIENCE, VOL. XLVI.

NEW HAVEN:
PRINTED BY B. L. HAMLEN.

1844.

NOTICE, &c.*

THIS important memoir by the illustrious Ehrenberg, is characterized like all the preceding works of this author, not only by marks of the most accurate research and indefatigable industry, but by the still higher merit of far-reaching philosophical views, and a just appreciation of the important bearings and applications of the facts which he has brought to light.

Believing that this memoir is one of peculiar interest to American science, we have endeavored to give in the following pages as correct a view of its contents as is in our power.

The work is divided into the following seven parts, which we intend to notice in order. 1. Introduction. 2. Review of the materials. 3. Enumeration of the American forms, according to the dates of observation. 4. Alphabetical review of all the observed and peculiar forms. 5. Characteristics of the new genera and species. 6. General results of these observations. 7. Explanation of the plates.

I. *Introduction.*—In the commencement, Ehrenberg remarks that microscopic life no longer belongs to the domain of systematic zoology alone, but that its decided influence upon the inanimate nature which every where surrounds and influences us, and upon the fundamental notions of life itself, have of late been recognized, so that the subject is no longer considered merely with regard to its organic and physiological bearings, but for its relations to the inorganic masses of the earth. There are many, however, who still wish to banish these investigations from the circle of strict science, and who wonder that any one should devote so much labor to the strict examination of such inaccessible and remote objects. These prejudices are compared to those which prevented the importance of the first noticed electric and magnetic phenomena from being appreciated, and which long

* Verbreitung und Einfluss des Mikroskopischen Lebens in Süd und Nord Amerika, Ein Vortrag von C. G. Ehrenberg. Gelesen in der Königl. Preuss. Akademie der Wissenschaften zu Berlin, am 25 März und 10 Juni, 1841, mit spätern Zusätzen. Nebst 4 coloriten Kupfertabeln. Berlin, 1843.

left them as mere subjects of amusement, although at present regular professors of electricity and magnetism are established at all the universities of the civilized world.

The author hopes that the continuation of his labors will show, that however much that is untenable may have been presented in science of late, the objects and results of microscopic research are by no means such as to prevent the strictest critical examination, and that they can even be subjected to the best of all tests, ocular demonstration.

He then alludes to his discoveries with regard to the important influence which animalcules have had in filling up streams and harbors, and in the formation of deltas, and states that observations have now rendered it more obvious how rock-masses which are wholly or partially crystalline, may have resulted from the solution and change of minute siliceous and calcareous organisms.

II. *Review of the materials.*—The author in consequence of the various relations of microscopic life to the great field of nature, felt induced to compare the facts observed in Europe with the conditions of other parts of the world, and, accidentally, the American forms were the first examined. Among the materials for this study of the American forms, were specimens of edible clay from the banks of the Amazon, furnished by Von Martius; species collected in a living state in Mexico by the author's brother, Carl von Ehrenberg; earth attached to plants in herbaria; and "a whole box full" of fossil animalcules sent from the United States by Mr. B. Silliman, junior; by Professors Silliman, Hitchcock and Bailey; and a number of the living species of West Point were received directly from Prof. Bailey in the year 1842.

From the results of the investigation of these materials, Ehrenberg is enabled to present a view of the minutest forms of animal life, extending from the Falkland Islands on the south, to Labrador, Kotzebue's Sound, Iceland and Spitzbergen on the north.

III. *Enumeration of the American forms, according to the date of observation.*—This detailed enumeration of species from different localities is full of interest, but our limits compel us to give but brief notices of many of the localities, and to confine our attention chiefly to the most important observations concerning the localities in the United States. We remark however that among the species detected with sea *Confervæ* from the *Falkland*

Islands are several species which have also been found recently in mud from Boston harbor; among the most remarkable of these are *Stauroptera aspera*, *Navicula Lyra*, *Pinnularia peregrina*, &c.

The forms from *Peru* were obtained from Algæ sent to Ehrenberg by the distinguished algologist, Dr. Montagne, and from swamp earth, adhering to a plant in Kunth's herbarium, which was collected in the year 1777. All the genera but one (*Podosira*) are European, and this one has lately been found in Iceland.

In describing the *Brazilian* forms, the author states that in the edible clay of the Amazon, he has detected four species of decidedly fluviatile siliceous infusoria, and seven species of siliceous parts of plants; among the latter is *Amphidiscus rotula*, which also occurs at West Point, N. Y. According to the accounts of trustworthy travellers, the edible infusorial clay of the Amazon, exists as an elevated and wooded plain, forming an extensive stratum, in no way resulting from the present action of the Amazon. It is neither the sediment of a swamp, nor a product of the overflowings of the river, but an older deposit, whose age however cannot yet be decided.

In the volcanic mud, called Moya, brought from *Quito* by Humboldt, which is so rich in carbon that it has been used as fuel, Ehrenberg detected ten different species or fragments of organic forms, and proved by microscopic observation that charred parts of plants form a large part of this substance, mingled however with fluviatile siliceous infusoria.

Among the numerous species from *Cuba* we notice *Biddulphia pulchella*, a truly elegant form, which will probably be found at many places on our sea-coast, as it has been detected near the Pavilion at Rockaway, Long Island.*

The materials from *Mexico*, furnished by Carl von Ehrenberg, were collected at different elevations, from eight thousand five hundred and fifty six feet above the sea, down to the sea itself. Numerous interesting species, not only of siliceous animalcules and parts of plants, but also of soft-shelled infusoria, were found. The most remarkable siliceous infusorial form is the fresh-water species *Terpsinoë musica*, which presents the appearance of a double row of musical notes in a glass casket.

* See p. 141 of the present volume of this Journal. We have also recently found it, in company with many other beautiful infusorial and Polythalamian forms, in mud adhering to oysters dredged at Amboy, New Jersey.

No less than one hundred and twenty forms of siliceous and calcareous animalcules and siliceous parts of plants were detected by Ehrenberg among marine Algæ brought from Vera Cruz by his brother. Among the figures of these forms, we notice fig. 43, plate 3, (*Planularia? Pelagi*,) as strikingly like a fossil Polythalamian shell, abundant in meiocene tertiary of Petersburg, Va.

We pass now to the notice given by Ehrenberg of the localities of the United States, and we regret that our limits will not allow us to insert his account without abridgment.

"The first specimen of the infusoria of the United States which I received, consisted of a portion of the fossil infusoria from West Point, a specimen of which was sent over by Dr. Torrey, and received in 1839. Since that time the richest American materials have been obtained from the United States, where the distinguished native men of science have devoted themselves to the examination of these relations with great zeal and success.

"*Richmond, Va.*—A rich booty, consisting of the fossil forms alone of Virginia, has been discovered by the exertions of Prof. W. B. Rogers, the geologist of Virginia. Some of the species have been represented in Prof. Bailey's sketch of American Bacillaria, and he alludes to the apparent resemblance of this geological formation to that of Oran. The strict comparison of these relations possesses now a peculiar geological interest. I have taken the following list of 11 Virginian fossil forms from Prof. Bailey's memoir.

<i>Bailey.</i>	<i>Ehrenberg.</i>
1. Pyxidicula, fig. 2,	= Pyxidicula cruciata.
2. Gallionella sulcata, fig. 7,	= Gallionella sulcata.
3. Actinocyclus sulcata , fig. 10,	= Actinoptychus octonarius.*
4. " " fig. 11,	= " senarius.
5. Coscinodiscus lineatus, fig. 12,	= Coscinodiscus lineatus.
6. " patina, fig. 13,	= " minor.
7. " radiatus, fig. 14,	= " gigas.
8. " argus,	= " argus.
9. " oculus iridis,	= " oculus iridis.

"In the specimens of the tertiary 'infusorial stratum' of Richmond, kindly sent to me through Prof. Bailey from Prof. Rogers, I have, up to this time, observed the following fifty forms, and have compared them directly with the European forms, and also with those from Oran in Africa.

* Under the new genus Actinoptychus are now placed those species of the old genus Actinocyclus which possess internal partitions or folds, while under the old name are retained those in which the external rays are not connected with internal folds.

A. Siliceous Infusoria.

- | | |
|----------------------------|----------------------------------|
| 1. Actinocyclus quinarius. | 24. Coscinodiscus oculus iridis. |
| 2. " denarius. | 25. " radiatus. |
| 3. " undenarius. | 26. " radiolatus. |
| 4. " duodenarius. | 27. Dictyocha crux. |
| 5. " bioctonarius. | 28. " fibula. |
| 6. Actinoptychus senarius. | 29. " pentasterias. |
| 7. " octonarius. | 30. Eunotia diodon. |
| 8. " duodenarius. | 31. " monodon? |
| 9. " sedenarius. | 32. Fragillaria amphiceros. |
| 10. " denarius. | 33. " lævis. |
| 11. " vicenarius. | 34. " pinnata. |
| 12. " Jupiter. | 35. Gallionella sulcata. |
| 13. Amphora libyca. | 36. Goniothecium Rogersii. |
| 14. Biddulphia tridentata. | 37. Grammatophora oceanica. |
| 15. Cocconeis amphiceros. | 38. " undulata? |
| 16. " leptoceros. | 39. Haliomma —? |
| 17. Coscinodiscus argus. | 40. Himantidium Arcus? |
| 18. " concavus. | 41. Navicula sigma. |
| 19. " limbatus. | 42. Pinnularia peregrina. |
| 20. " lineatus. | 43. Pyxidicula cruciata. |
| 21. " marginatus. | 44. Rhizosolenia Americana. |
| 22. " gigas. | 45. Stauroptera —? |
| 23. " minor. | 46. Triceratium obtusum. |

B. Siliceous parts of Plants.

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|-------------------------------|---------------------------|
| 47. Spongiolithis acicularis. | 50. Spongiolithis clavus. |
| 48. " caput serpentis. | 51. " fistulosa. |
| 49. " cenocephala. | 52. " fustis. |

"Among these fifty two forms are forty six infusoria, belonging to twenty genera, which genera are all European with the exception of two, *Goniothecium* and *Rhizosolenia*,* which have not been observed

* "*GONIOTHECIUM*. Genus e familia Bacillariorum, sectione Naviculaceorum. Lorica simplex silicea teres nunquam catenata, strictura media fine utroque subitò attenuato, et truncato hinc tanquam anguloso. = *Pyxidicula* media constricta utrinque truncata."

"*G. Rogersii*, articulis lævibus hyalinis."

"*RHIZOSOLENIA*. Genus e familia Bacillariorum, sectione Naviculaceorum. Characteres *Pyxidiculae* aut *Gallionellæ*, loricae tubulosæ altero fine rotundato clauso, altero attenuato multifido tanquam radiculoso."

"*R. Americana*, testulae tubulis hyalinis lævibus."

"A curious and very distinct form, whose systematic position is uncertain; only three specimens were seen, all of which were imperfect."

at any other locality. Of the species, ten, or almost one fifth, are new and peculiar.

"Many of the forms occurring in the deposit are, as Prof. Bailey quite correctly concluded from his smaller number of observations, similar to those of Oran, but many of these forms also do *not* occur at Oran. According to the materials now furnished for comparison, the true relations are such, that of the eleven species of the genus *Coscinodiscus*, five occur at Oran which are also found at Richmond, five are found at Richmond alone, and one at Oran alone. Of thirteen species of *Actinocyclus*, three agree at both localities, eight occur only at Oran, and two only at Richmond. Of eight species of *Actinopterychus*, three occur at both places, four in Richmond and one in Oran alone, &c.

"As a considerable number of the species of animals belonging to the chalk formation of Sicily still exist, and consequently cannot be wanting in the tertiary formations, it is evident that no conclusion as to the geological age of these formations can be drawn from the similarity or dissimilarity of these forms.

"This group of American forms is of peculiar interest and scientific importance, because the strata at Richmond are decidedly of marine origin, and consequently give at once a general view of the marine microscopic animals of the North American ocean; for probably the greater number of species are still living there, as they have already been found abundantly on the German coast of the North Sea.* The geological position of the strata must be determined by the order of superposition, the larger included organic remains, &c. as it cannot be decided by means of the infusoria.

"*West Point, N. Y.*—The discovery of a bed of fossil infusoria at West Point, N. Y. was announced by Prof. Bailey in the *American Journal of Science*, Vol. xxxiv, July, 1838; in the year 1839 I received through Humboldt a specimen of this deposit from Dr. Torrey, and in February of the same year I made a report concerning it to the Academy at Berlin. To the fifteen organic forms then mentioned many others have been added by further examination."

Ehrenberg then gives a list of sixty two organic forms detected by him in the fossil specimens from West Point, among which are forty seven independent organisms, (animalcules,) of which only one, *Amphiprora*, belongs to a new genus; all the rest belong to twelve European genera. Only seven species, or about one seventh of the whole, can be considered as peculiar. By far

* Many of these species have been known for some time to exist in a living state, not only upon our sea-coast, but up to the limits of brackish water in many of our rivers.

the greater number appear to agree with European forms. He then continues, thus—

“Besides these fossils, which occur directly under the surface of a peat-bog, and which consequently belong most probably to recent species, I have also had an opportunity to examine a great number of not only recent but still living forms from West Point. Prof. Bailey sent me in the year 1842 some phials full of turf-water from West Point, containing many living species of Bacillaria. These were filled with water at West Point on the 2d of April, 1842, and on the 16th of June I was able to show many of them in a living state at Berlin. I have endeavored to compare all these living or decidedly recent American species with the European, and have consequently drawn figures of all of them. At the same time Prof. Bailey sent me a printed memoir, in which he describes some of the fossil infusoria of Virginia, and a considerable number of recent species from various places in the United States, and particularly from West Point. The following is a list of the species found at West Point, which Prof. Bailey has observed and figured in Parts I and II of his memoir on American Bacillaria.”*

As this list furnishes the authentic names of the species figured in this memoir, we give it entire, believing that it will be valuable for reference.

I. DESMIDIACEA. (See Part I of Bailey's Bacillaria.)

Fig. 1. <i>Desmidium Swartzii</i> ?	= <i>Desmidium Swartzii</i> .
2, 3. <i>Euastrum</i> ?	= “ <i>tridens</i> .
4, 5. “ ?	= “ “
6. “ var.	= “ “
7. “ var.	= <i>Pentasterias radiata</i> ?
8. “ <i>margaritifera</i> ,	= <i>Euastrum margaritifera</i> .
9. “ al. sp.	= <i>Desmidium aculeatum</i> .
10. “ al. sp.	= <i>Xanthidium fasciculatum</i> .
11. “ al. sp.	= <i>Arthrodesmus convergens</i> .
12. “ al. sp.	= “ <i>quadricaudatus</i> , p.
13. “ al. sp.	= <i>Xanthidium bisenarium</i> .
14. “ al. sp.	= <i>Desmidium glabrum</i> .
15. <i>Xanthidium</i> al. sp.	= * <i>Xanthidium arctiscon</i> .
16. “ al. sp.	= * “ <i>coronatum</i> .
17. <i>Arthrodesmus quadricaudatus</i> ,	= <i>Arthrodesmus quadricaudatus</i> .
18. “ <i>acutus</i> ,	= “ <i>acutus</i> .
19. <i>Micrasterias Tetras</i> ,	= <i>Micrasterias Tetras</i> .

* This list includes only the species mentioned in Parts I and II of Bailey's American Bacillaria. Part III, including the Echinellæ, and various Spongiolites, Phytolitharia, and Dictyochæ, had not reached Ehrenberg when this list was made out.

Fig. 20. <i>Micrasterias Boryana</i> ,	= <i>Micrasterias Boryana</i> .
21. " al. sp.	= " elliptica.
22. <i>Euastrum Rota</i> ,	= * <i>Euastrum Sol.</i>
23. " <i>Crux Melitensis</i> ,	= " <i>Crux Melitensis</i> .
24. " <i>Rota juvenile</i> ,	= " <i>Rota juvenile</i> .
25. " al. sp.	= * " <i>Americanum</i> .
26. " al. sp.	= " <i>Pecten</i> .
27. " al. sp.	= " <i>ansatum</i> .
28. " al. sp.	= * " <i>carinatum</i> .
29. " al. sp.	= " <i>Crux Melitensis juv?</i>
30. <i>Closterium lunula</i> ,	= <i>Closterium lunula? turgidum?</i>
31. " <i>moniliferum</i> ,	= " <i>moniliferum</i> .
32. " <i>Trabecula</i> ,	= " <i>crenulatum</i> . <i>nu</i>
33. " <i>digitus?</i>	= (<i>Polysolenia Closterium?</i>)
34. " <i>lineatum</i> ,	= <i>Closterium turgidum</i> .
35. " <i>striolatum</i> ,	= " "
36. " <i>rostratum</i> ,	= " <i>setaceum</i> .
37. " <i>tenue?</i>	= " <i>tenue?</i>
38. " al. sp.	= " (<i>Trabecula?</i>)

II. NAVICULACEA. (See Part II of Bailey's Bacillaria.)

Fig. 3. <i>Gallionella moniliformis</i> ,	= <i>Gallionella moniliformis</i> .
4. " <i>aurichalcea</i> ,	= " <i>aurichalcea</i> .
5. " <i>distans</i> ,	= " <i>distans</i> .
6. " <i>varians</i> ,	= " <i>varians</i> .
7. " <i>sulcata</i> ,	= " <i>sulcata</i> .
8. " ? al. sp.	= * <i>Biddulphia? lævis</i> .
17. <i>Navicula viridis</i> ,	= <i>Pinnularia viridis</i> .
20. " al. sp.	= " <i>Suecica?</i>
21. ? <i>striatula</i> ,	= <i>Surirella splendida</i> .
23. <i>Navicula al. sp.</i>	= * <i>Stauroneis Baileyi</i> .
26. <i>Eunotia Arcus</i> ,	= <i>Eunotia Westermanni</i> .
28. " <i>monodon</i> ,	= " <i>monodon</i> .
29. " <i>diodon</i> ,	= " <i>diodon</i> .
30. " <i>triodon</i> ,	= " <i>triodon</i> .
31. " <i>tetraodon</i> ,	= " <i>tetraodon</i> .
32. " <i>pentodon</i> ,	= " <i>quinaria</i> .
33. " <i>serra</i> ,	= " <i>decaodon</i> .
35. <i>Bacillaria paradoxa</i> ,	= <i>Bacillaria paradoxa</i> .
36. " <i>tabellaris</i> ,	} = <i>Tabellaria trinodis</i> .
37. " <i>tabellaris adultior</i> ,	
40. <i>Fragillaria pectinalis</i> ,	= <i>Himantidium Arcus</i> .
41. " <i>bipunctata</i> ,	= <i>Fragillaria rhabdosoma</i> .
42. <i>Meridion vernale</i> ,	= <i>Meridion vernale</i> .

"The deposit at *Andover* is extremely rich in forms belonging to the genus *Trachelomonas*, and it may consequently be stated that it is to a considerable extent formed of loricated monads.

"The deposit at New Haven is remarkable for the abundance of that exceedingly minute species, the *Staurosira construens*, whose numbers bear a larger proportion to the mass, than that of the *Gallionella distans* does in the polishing slate of Bilin."

Rhode Island.—Lists of marine species from Providence Cove, and fossil species from the extensive fluviatile deposit discovered by Owen Mason, Esq. in 1838, are given by Ehrenberg, but they include only three new forms.

Massachusetts.—Ehrenberg states that the knowledge of the microscopic organisms of Massachusetts has been greatly extended by Prof. Hitchcock, who discovered many deposits of these fossils during his geological survey of that state in the year 1838. Specimens from Andover, Boston, Bridgewater, Pelham, Spencer, and Wrentham, received from Profs. Hitchcock, Silliman, and Bailey, have been examined by Ehrenberg, who gives long lists of the species noticed from each locality, with remarks upon each, from which we select the following.

"From Spencer, in Massachusetts, I received through Prof. Hitchcock large pieces of a very white siliceous marl (*Kieselguhr*) having the coherence and color of chalk, but much less dense. I am in doubt whether this color is natural or produced by ignition. * * * I might conclude that it resulted from ignition, as this matter has been submitted to chemical analysis by Prof. Hitchcock, but on the other hand it may have been analyzed precisely on account of its whiteness and purity."

The species included in the list for this locality, are all fluviatile except the Polythalamian *Rotalia globulosa*, which being a decidedly marine species, Ehrenberg concludes that the deposit must either be situated near a chalk formation, or else near the sea. We have already stated (in this Journal, Vol. XLIII, p. 394) our belief that some chalk must accidentally have been mingled with Ehrenberg's specimens, as neither the geological nor geographical situation of Spencer is such as Ehrenberg suggests. Neither can we detect any *Rotalia* in our specimens.

Ehrenberg mentions three kinds of iron ochre, sent by Prof. Hitchcock from Newbury, Bradford, and Marlborough, but he was unable to detect in them *Gallionella ferruginea*, or any other organic forms. If they ever existed in these specimens,

Many of the species for which Ehrenberg has here furnished the names are new. We take this opportunity to mention that Ehrenberg has been misled by the outline figure 28, and has supposed it to represent a *carinated* *Euastrum*, which he has consequently named *Euastrum carinatum*. It is *not* carinated. The species fig. 8, Pl. II, which he doubtfully refers to *Biddulphia*? *lævis*, does not appear to us to belong to *Biddulphia*. Its cylindrical form and various other characters assimilate it more closely to *Gallionella*. It also appears allied to *Actinocyclus*. The species referred to *Pinnularia* have been separated from the old genus *Navicula*. We do not think that fig. 29 is a young state of *Euastrum Crux Melitensis*, as we have seen adult specimens still retaining the usual form. In continuation Ehrenberg remarks :

“Among these fifty three species of infusoria, seven are peculiar, and are indicated by stars. Prof. Bailey’s observation of the living dentate species of *Eunotia* is of particular interest, as they have not as yet been detected in Europe in the living state, although the shells are numerous in the Bergmehl from Sweden and Finland. As I have reason to suspect that some of these forms while living form bands like *Fragillaria*, and consequently belong to the genus *Himantidium*, it is particularly desirable that attention should be directed towards them. It is possible that such bands have been confounded with *Fragillaria pectinalis*.”

Ehrenberg then presents a list of sixty nine recent organic forms from West Point, observed by him in a living state at Berlin, and illustrates them by forty five beautiful colored figures. The whole number of independent microscopic organisms known to Ehrenberg as existing at West Point is one hundred and thirty three, belonging to thirty six genera, of which only one (*Amphiprora*) is extra-European.

Connecticut.—In mentioning specimens of fossil infusoria from Connecticut Ehrenberg states, that though sent by B. Silliman, Jr. in 1838, he did not receive them in Berlin until October, 1840, owing to accidental delay in England. He then gives full lists of all the species noticed by him from Andover, New Haven, and Stratford, and erroneously attributes to Prof. Bailey the discovery of these localities.* The most interesting remarks concerning these lists are the following :

* The specimens alluded to were obtained by B. Silliman, Jr. and the late Rev. James H. Linsley.

he thinks they must have changed into the fine siliceous sand, which is present in these ochres.

Maine.—Lists of the fossil infusoria from two different deposits discovered in 1838, near Blue-Hill Pond, in Maine, by Dr. Charles T. Jackson, are given. Both specimens were of a chalky whiteness, and all the forms, with the exception of various Spongiolites, (which are particularly abundant in one sample,) are decidedly fluviatile. Ehrenberg remarks on the difficulty of decision caused by the presence of these apparently marine spiculæ of sponges, and says :

“ We may ask, if the formation is marine, why are no *Coscinodisci*, *Actinocykli*, &c. to be found ? Perhaps it is a deposit from brackish water which in the neighborhood of the sea still contains some species of sponges.”

As these Spongiolites suggest similar remarks by Ehrenberg with regard to various localities, we would state, that there can be no doubt that they are certainly of fresh-water origin, although some of them have much resemblance to some marine forms. The circumstances under which they occur in numerous localities, hundreds of miles from the sea, and in the most recent deposits of bogs and streams, leave no doubt of their fluviatile origin.

The notice of the species observed from Newfoundland, Labrador, Kotzebue's Sound, Iceland, and Spitzbergen, we are obliged to omit.

In concluding this enumeration of American localities, Ehrenberg remarks :

“ That the extent and influence of the minuter American forms of animal life now known to him does not terminate here. At the above mentioned localities, the forms are chiefly siliceous, but microscopic calcareous organisms have also a most important development in America.”

Allusion is then made by the author to the vast extent of the cretaceous formations on the American continent, as shown by Dr. Morton's Synopsis of the Cretaceous Group, and Von Buch's splendid Memoir on the Petrifications collected by Humboldt in America. Ehrenberg then observes :

“ Since the Academy was informed in 1838 that by a peculiar method of observation, it is possible to prove that all writing chalk and many compact calcareous rocks, result from the agglomeration of invisible *Polythalamia*, this method was applied in 1841 by Prof. Bailey to the cretaceous rocks of North America, and the same results obtained.*

* See this Journal, Vol. xli, p. 213 and p. 400.

14 Notice of Ehrenberg's Memoir on Microscopic Life.

The specimens from Missouri, Mississippi, and New Jersey, sent to me by Prof. Bailey in 1842, for further examination and determination of the forms, have removed all doubts concerning this exceedingly great influence of minute life, which must now be looked upon as a well established scientific fact, and must be attended to in considering the geognostic relations of the earth, and particularly the development of the surface of the earth in all central North America. It would lead too far, to give all the particulars of the rich results lately obtained from these examinations, and as I shall have occasion, in a larger work which is now nearly completed, to present all these details with drawings, comparing all the chalk formations of America, Europe, Asia and Africa, I limit myself to this general notice. But be it remarked, that many of the species of European chalk Polythalamia also occur in Asia, Africa, and America,* while some are wholly local. To the latter belong the *Textilaria Americana*,† whose first and lowest cells are round, while the upper largest cells are always wart-like, longer, and sharper, and at last terminate in a point. This species forms the principal mass of the chalk of the Upper Missouri. Whether flint, or its equivalent, chalk marl with marine infusoria, occurs there, is still unknown, and is very desirable to determine."

Part IV, contains an alphabetical list of all the microscopic American infusoria mentioned in this work, with the localities at which each has been found.

Part V, gives the characteristics of the new genera and species.

Part VI, includes the general results of the examination, viz.

1. There is here presented the first general view of the hitherto unknown character of the surface of the earth, for all zones of the whole continent of America.

2. It proves that not only in situations rich in humus, but also in sandy places of the surface of America, from near the south to near the north pole, there exists an organic life generally invisible to the eye, and that the bottom of the sea is filled with such organic forms.

* The identity of some of the American Polythalamia with those of England, Africa, and Asia, was made known by us in this Journal, Vol. xli, p. 400, and in the Proceedings of the American Association of Geologists and Naturalists, Vol. I, pp. 356-7.

† Ehrenberg gives no figure of this species, but it undoubtedly is the same as that represented in outline in the annexed cut, which we have drawn from the species most abundant in our specimens of the Missouri chalk marl. Outlines of some of the other forms will be found in this Journal, Vol. xli, p. 400.



3. The whole number of microscopic forms included in this review amounts to six hundred and three, of which four hundred and fifty are Polygastrica, six Rotatoria, eight fragments of plants, (chiefly Phytolitharia,) fifty six Polythalamia, and two other bodies.

4. All of these six hundred and three minute American organisms are included in one hundred and three genera, of which twenty five, or almost one fourth, are new, but seventy nine, or about three fourths, were already known and established. Of these one hundred and three genera, sixty four (including six which are peculiar) belong to the four hundred and fifty Polygastrica. The six Rotatoria belong to five known genera. The small forms, consisting of parts or fragments of organic bodies, are assembled in eleven genera. The Polythalamia belong to twenty genera, of which five are new and fifteen already known.

Of the four hundred and fifty species of Polygastrica, two hundred and fifty nine, or thirty four more than one half, were hitherto unknown, and about one third are peculiar to America, but two thirds are European. Many of the forms here first named have recently been found in Europe.

In America as in Europe, the genera richest in forms are, Eunotia with forty six species, Navicula and Pinnularia each with forty five species. Then follow in the order of the number of species, the genera Gomphonema twenty one, Cocconeis nineteen, Stauroneis eighteen, Fragillaria, Surirella, seventeen.

It is remarkable that all the genera distinguished as peculiar, have presented but few and generally single species.

5. Drawings of three hundred and twenty five American invisible organisms are given, and three hundred and ten are first introduced into the systematic list by short characteristics.

6. These examinations have led to the establishment and systematic review of two hitherto unconsidered great groups or families of microscopic bodies, which indeed are not independent organisms, but have nevertheless the same worth for geological researches, viz. the uncrySTALLINE siliceous bodies arranged under the family name *Phytolitharia*,* and the organized calcareous fragments referred to the family *Zoolitharia*. Like all other species of fossils, these are suited to form a good basis for geological conclusions.

7. The eleven species whose names are given in the following list, distinguish themselves from all others by their distribution, and consequently their influence. They may be considered as cosmopolites, (Weltbürger,) as they are found agreeing in character from the most

* Various Phytolitharia are represented in this Journal, Vol. XLIII, Pl. 5, figs. 17 to 35, and in Hitchcock's Report on the Geology of Massachusetts, Vol. II, Pl. 20, fig. 29.

southern end of South America to the polar extremity of North America, or through a range of more than 50° south to 60° north latitude.

**Cocconeis placentula*.

* " *Scutellum*.

**Eunotia amphoxyys*.

" *biceps*.

" *Faba*.

**Fragillaria rhabdosoma*.

**Gomphonema clavatum*.

" *minutissimum*.

**Pinnularia viridis*.

**Stauroptera aspera*.

**Spongiolithis acicularis*.

Those distinguished with a * are found agreeing in characters in Central America and in Europe.

8. Six species are distinguished from all the others by the peculiarity of their forms, and are placed under the genera *Climacosphenia*, *Goniothecium*, *Podosira*, *Rhizosolenia*, *Sphenosira* and *Terpsinoë*.

The music animalcule, *Terpsinoë musica*, which resembles a printed sheet of music with twelve notes, standing by sixes in two rows, is remarkably distinct from any European form.

9. In America as in Europe, there occur not merely untraceable, transient, momentary appearances of the minutest forms of life, but also wide-spread fossil strata of their easily recognizable remains, which form earthy and even rocky masses.

10. The only American microscopic organisms which form earth and rocks, are, as in Europe, the siliceous infusoria or the calcareous Polythalamia.

11. There occur in North America (Andover, Wrentham, Mass.) fossil beds of siliceous earth, which are to a considerable extent composed of loricated monads, (*Trachelomonas*,) and not formed as usual merely of *Bacillaria* and *Phytolitharia*. Iron ochre occurs also in Massachusetts, which is very similar to the *Gallionella* deposits.

12. Beds of minute fossil siliceous organisms have been observed of the thickness of fifteen feet at Andover, and twenty eight feet at Richmond. Similar beds occur by the Amazon in South America, and in great extent from Virginia to Labrador.

13. The relations of the invisible calcareous Polythalamia are also the same in America as in Europe; indeed, the first short examination alone has proved their gigantic development. They may be distinctly recognized as forming the firm earth and the rocks of central North America, as a cretaceous formation from New Jersey to the sources of the Mississippi near the Rocky Mountains.* Even the Andes of the

* Those who are not familiar with American geology should bear in mind that the cretaceous formation only exists as a narrow belt along the Atlantic slope, skirting the older formations which occupy the greater portion of the United States, and that it is chiefly in the far west that it has the gigantic development alluded to by Ehrenberg.

equatorial regions belong to the same chalk formation, and they may consequently be a purely organic product, in a changed condition, produced by the sudden or gradual operation of great volcanic action.

14. There exists in America, (Quito, Massachusetts, Iceland,) as in Europe, combustible earth, serviceable as a kind of peat, which is composed in a great part, even to one third of the mass, of (dead?) microscopic animalcules, besides the remains of plants.

15. In America (Maine) as in Europe, and still earlier in Asia Minor, a technical application of the infusoria has been made for the purposes of building stone, [bricks,] and for polishing-powder.

16. If, besides considering minute life with regard to its distribution over the surface, we attend also to its extent in depth, or in the mass of the earth, we find it established by careful examinations made by eminent American geologists, that some of the fossil beds of minute siliceous shells belong to the tertiary formation, (Richmond.)

With regard to the forms with microscopic calcareous shells, the researches of the most experienced and careful geologists prove that the often noticed far-extended North American [Polythalamian] limestones, belong to the chalk or secondary formations.*

17. The formation of humus is, in America as in Europe, so dependent upon or accompanied by, invisible independent organic life, that most of those lumps of earth which are overlooked, and which remain adhering to plants when they are cleaned for herbaria, contain preserved whole groups of such organisms.

18. The method of examining the portions of humus from distant parts of the world proves, as the result here presented shows, that one observer, with one and the same instrument, can in a short time make a scientific review and comparison of the invisible minute life of all parts of the earth, and under circumstances the most favorable for scientific examination.

As it is possible to obtain from the plants in herbaria, the smallest materials used in the structure of the earth in all zones, so it is likewise possible, without change of place, to obtain similar results from all parts of the ocean, by examining the matter which adheres to anchors and sounding leads, and the food consumed by various sea animals. The Medusæ and Ascidia in particular are often filled with these forms.

Perhaps there may yet be found in the Coprolites of the transition rocks (Uebergangstein) what has been destroyed during the metamor-

* No infusorial or Polythalamian forms have yet been detected in our Silurian deposits, but they abound in the tertiary and cretaceous group, and we are indebted to Dr. David Dale Owen, of New Harmony, for well characterized Polythalamia from the oolitic portions of the carboniferous (Pentremite) limestone of Indiana.

phosis of the older rocks, as the minutest forms must most easily be destroyed.

19. The opinion of some modern naturalists, that the species of animal organisms by increasing weakness gradually lose the organic constitution, (*durch wachsende Schwäche der organischen Constitution aufzehren,*) is not confirmed by the smallest forms, either in Europe or America, but on the contrary there occur also in America certain forms which, since a period long anterior to the historic epoch, and in all climates, have perfectly preserved the ~~same~~ ^{arbitrary} characters.

20. The sport of plastic nature, with pleasing ^{arbitrary} changes of form, (*mit beliebigem Formen-Wechsel,*) does not occur, even with the minutest forms, any where on the western continent, whether at the equator or the poles; but it has been proved that on both hemispheres and from pole to pole, there exists a group of forms which, with characters unchanged from the chalk formation to the present time, have played a great part as similar building-stones in the structure of the surface of the earth.

21. From the rapid and great increase of this knowledge of *an independent deep-working life in the smallest space*, it follows that this field of research cannot be unworthy of the best efforts; and if it is not always equally and quickly productive, or if it may be more agreeable with easier speculation, and rather in poetic sport, than seriously to penetrate into the Remote; yet the only scientific and remunerating method is by slow and sure steps, and under the check of careful and therefore laborious research, to approach the goal which excites the mind of all thinking men of all generations, and will interest all generations yet to come.

Part VII, contains the explanation of the Plates, which are four in number. These are large and beautifully executed, and contain seven hundred figures, including three hundred and twenty five of the *recent* minute organisms from all zones of America. The *fossil* species are omitted on account of their number, but Ehrenberg states that they are already engraved for a larger work, which will soon be published. He also states, that nearly all the figures are drawn from prepared specimens which he still retains as a durable collection which can be employed for unlimited comparisons in future.

In concluding our notice of this valuable paper, we cannot but remark, that although the results already obtained are certainly most important, and although Ehrenberg has made the best possible use of the materials in his possession, yet much remains to be done, (as no one knows better than Ehrenberg himself,) before,

the whole extent and influence of microscopic life in America can be fully understood and appreciated. Hundreds of species of marine and fluviatile siliceous infusoria, not mentioned in Ehrenberg's list, are known to us, and myriads of the more perishable forms occur in all our waters. The soft and gelatinous forms of these must prevent their being sent across the Atlantic, and it remains for our naturalists to compare them with the European species represented in Ehrenberg's magnificent volume on infusoria. Important information with regard to the infusoria of the United States has already been accumulated by several of our naturalists, among whom we may mention the names of Thomas Cole, Esq. of Salem, and Dr. P. B. Goddard, of Philadelphia, both of whom are accurate and zealous observers.

With regard to our Polythalamian forms, we can state, that they exist at various localities not yet known to Ehrenberg. Besides the numerous living species of our coast, our tertiary formations are filled with characteristic and beautiful forms which we have detected in specimens from various localities, as Petersburg, Va., Wilmington, N. C. We have also found them in marl from near Astoria, Oregon Territory, brought by Mr. James D. Dana, and in carboniferous limestone from Indiana, furnished us by Dr. David Dale Owen. We have gradually accumulated many figures of these forms which we intended for publication, but as Ehrenberg has now undertaken the subject of American Polythalamia, we believe that we cannot do better than to place all our materials in his hands; and as it is desirable to supply him with specimens from as many localities as possible, we take this occasion to invite the friends of science, who may be so situated as to be able to comply with the request, to forward to us specimens of the cretaceous and tertiary deposits of the United States. Specimens from the "rotten limestone" of Florida and Alabama, and from the cretaceous beds of Tennessee, &c. are highly desirable. Even the minute portion which can be sent in a letter will often give most important and valuable results. Specimens of the sediment of our rivers and harbors, particularly from those of the southern regions of the United States, will also be very acceptable.*

* Specimens may be sent addressed to J. W. Bailey, West Point, N. Y., care of Dr. J. R. Chilton, 263 Broadway, New York; or to B. Silliman, Jr., New Haven, Conn.

